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LIGNITE MINING IN PTOLEMAIS, GREECE

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LIGNITE MINING IN PTOLEMAIS, GREECE

by

V.Srajer *

ABSTRACT

The Ptolemais basin mines were visited on Monday, November 17, 1986. In this report, an overview of the surface mining lignite operation is presented. The annual production from the Ptolemais basin in 1984 was around 27 Mt. The lignite is mainly used for power generating stations located near the mines, and for domestic and industrial use (nitrogen fertilizer plant).

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EXPLOITATION MINIÈRE DE LA LIGNITE À PTOLEMAIS, EN GRÈCE

par

V. Srajer*

RÉSUMÉ

L'auteur a visité les mines du bassin de Ptolemais le lundi 17 novembre 1986. Le rapport présente une vue d'ensemble de l'exploitation en surface de la lignite. La production annuelle du bassin de Ptolemais a été d'environ 27 000 tonnes en 1984. La lignite sert principalement à la production d'électricité dans des centrales situées près des mines, et à des fins domestiques et industrielles (usine d'engrais azoté).

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INTRODUCTION

The Ptolemais basin is located in West Macedonia in Greece, on the secondary road from the town of Skopje in Yugoslavia to Kozani in Greece, approximately 80 km south from border town of Florina. The mines are located east of the Ptolemais-Kazani highway, with the main office being 5 km south of the town of Ptolemais. The location of the basin is apparent from the Fig. 1 (1). The Ptolemais basin contains approximately 80 % of the total lignite reserves of Greece. This basin is a part of a greater tectonic basin, which starts north near the Yugoslavian border and extend south beyond the town of Servia. Basin elevation averages 700 m above Mediterranean Sea Level (MSL) and the total area of the Amynteon to Kozani sub-basin is 400 km^2.

The mines were visited to review the predominantly continuous mining technology employed at the mine and to establish contacts with mine engineering and management personel. The presented trip report provide an overview of the mine operations, mining methods and equipment used at the visited mine fields. The author experienced difficulty in taking photographs in the mine, because of the heavy overcast and fog experienced during the visit. Only two pictures of the Komanos pit taken at the end of the visit were found suitable for inclusion in this report.

PTOLEMAIS BASIN

Lignite deposits.

The lignite basin is divided into smaller sub-basins with different structures due to vertical tectonic movements. The following sub-basins were identified:

1. Florina-Amynteon Valley,
2. Ptolemais-Kozani Valley, and

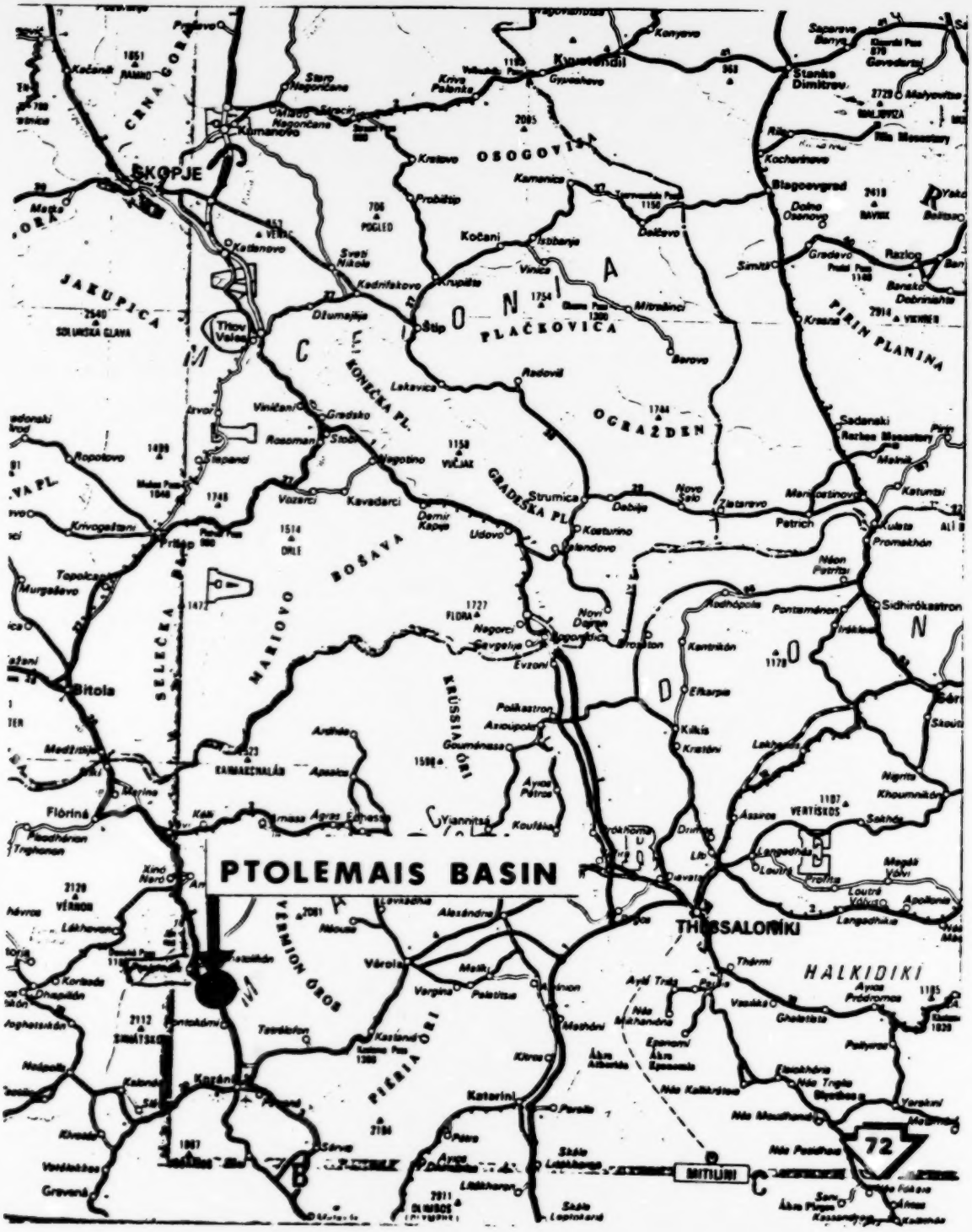

Fig. 1 - Ptolemais Basin Location

3. Kozani-Servia Valley.

The majority of lignite reserves are in the Ptolemais-Kozani sub-basin; the so called Central Deposit.

The geological reserves are estimated at 3.5 Gt of lignite. Of these reserves, about 2.5 Gt are mineable reserves under present economic and technological conditions. The Ptolemais mines field and its general section is shown in Fig.2 (2). Table 1 shows the mineable lignite reserves of the various fields as provided during the visit.

Table 1 - Lignite reserves

Field	Reserves (Mt)	Stripping ratio (m^3/t)
Amynteon-Lakia	300	9.35/1
Komnina	197	20.00/1
North	92	2.80/1
Main	124	2.20/1
Komanos	62	2.90/1
Kardia	197	2.40/1
South	1120	5.10/1
West	300	3.20/1
East	80	7.70/1
Petrana	100	10.00/1

The lignite deposit is a Pliocene age and autochthonais type; developed after the drainage of large swamp in the same area. There are up to nine lignite seams of a thicknesses greater than 50 cm. The average thickness of the individual coal seam is 1.8 m. An interbedded partings are having similar thickness. The mine benches are build up 12 to 31 m high, covering an agregate seam thickness of approximately 20.0 m.

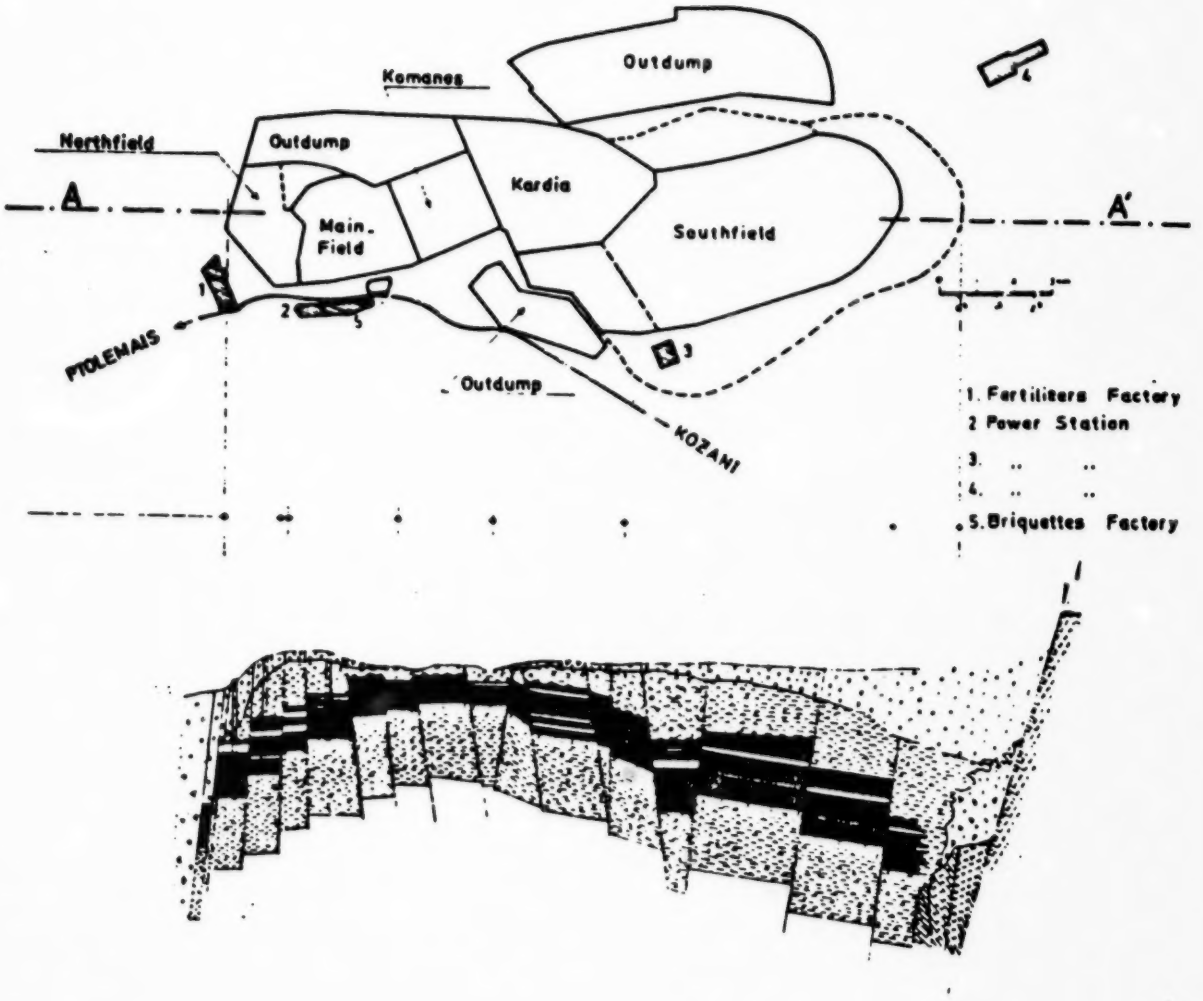

Fig. 2 - Mine Fields and General Section

The overburden consist mainly of marls with thin pebble conglomerates, sands or clays overlain in sequence above the lignite. The marl is covered with an allurial formation of clays and sands. The thickness of the overburden varies in operating pits from 12 to 230 m.

Brief information on existing or planned mines in the region is presented in Table 2.

Table 2 - Seams geometry summary.

Fields	Mean O/B thickness (m)	Mean partings thickness (m)	Mean mineable coal thickness (m)
North	41.95	31.95	15.80
Kariohori	25.90	19.80	17.30
Main	20.00	19.60	14.70
Komanos	16.30	19.60	12.40
Kardia	17.04	21.00	19.97
South	81.70	38.20	31.20
Amynteon	73.50	19.30	14.80

The lignite mined is quite soft in its natural state, and has a specific weight from 1.16 to 1.36 gr/cm^3. The mine developed classification of lignite into three categories: A, B, C. This division is based on the ash content as follows:

Lignite "A" : ash content less than 20.7 %,
Lignite "B" : ash content from 20.7 to 28.0 %, and
Lignite "C" : ash content from 28.0 to 35.0 %.

Only lignite type "A" is suitable for briquetting. The two other classes are utilized for power stations and gas generators. Lignite with an ash content over 35.0 % has no economic use.

Table 3 summarizes chemical composition of a common sample of lignite from the Ptolemais. It may be of interest to note, that according to mine calculations, 2.2 kg of lignite is needed to produce 1 kwh of electric power.

Table 3 - Composition of sample.

	Class "A" (%)	Class "B" (%)
A. ROM sample		
Water content	60.6	56.9
Pulv. fuel ash	6.9+3.3	12.4+5.7
Fixed carbon	13.2	11.9
Volatiles	13.0	12.8
B. Dry sample		
Pulv. fuel ash	17.6+3.9	28.7+6.4
Fixed carbon	33.4	27.6
Volatiles	33.1	29.8
Calorific value: (kcal/kg)		
lower	4697	3984
higher	4904	4155

The climatic conditions of the basin are continental, having maximum summer temperatures of up to +40° C. The lowest recorded winter temperature during last 20 years was -20° C. The annual mean precipitation is between 600 - 700 mm; rainfalls are strong and frequent during the spring and fall seasons. The mines have no drainage problems, because of the impermeable layers of marls and clays overlying and underlaying the lignite formation.

Very frequent foggy days during fall may cause problems in the mine area, keeping smog and other polutants close to the ground for several days at a time.

Mining Methods and Equipment.

The mining of the lignite seams, which are nearly horizontal, is by open cast mining using continuous mining equipment. The continuous mining equipment consists of electrically powered bucket wheel excavators, belt conveyors and stackers, manufactured in West Germany. The section of waste and coal with partings are divided into benches of a height from 10 to 30 m depending on the type of excavator used. The coal is transported to the power stations; waste and ash is deposited at the spoil. The spoils are located inside or outside mine area.

The first bucket wheel excavator was erected in 1958 and is still operating in the Main pit, with an output of 1600 m^3/h. Starting in 1980, the Main and Kardia pits were developed, having BWEs of operational time range from 4000 to 6300 hours annually. During the visit the following equipment was operational at the mines:

- 22 large excavators of capacity from 1,660 to 11,100 m^3/h,
- 14 smaller excavators of capacity from 900 to 2,667 m^3/h,
- 8 stackers of capacity from 4,200 to 6,700 m^3/h,
- 2 belt conveyor systems of capacity up to 1,500 m^3/h, and
- a fleet of 300 diesel machines (dozers, loaders, graders, shovels, trucks) for auxiliary mining work.

The total length of installed conveyors, for all open pits, is about 110 km, having belt widths of 1200, 1400, 1600, 1800 and 2400 mm. An electric train is also used to transport lignite from the Main field to the power station and for transportation of ash from the station back to the pit for backfilling. It was estimated that the total value of all equipment used at the mine is close to 70 billion Drachmas.

At present, the Prolemais basin is administratively divided into three units:

- open cast mine of Main-North-Komanos field,
- open cast mine of Kardia field, and
- open cast mine of South field.

The total production from all fields up to the end of 1984 year are given in the Table 4.

Table 4 - Total mine production.

Mines	Waste (Mm^3)	Lignite (Mt)	Remaining reserves (Mt)
Main-North-Kamanos	490	145	134
Kardia	328	107	90
South	100	2	1118
Total	918	254	1342

The mine productivity in 1984 per 8 hour person shift was 83.8 m^3 of waste and 22.6 t of lignite. The maximum productivity was reported from the Kardia field in 1984, being 147.5 m^3 per person shift. Fig.3 (2) is shows overall lignite production at Ptolemais since 1960.

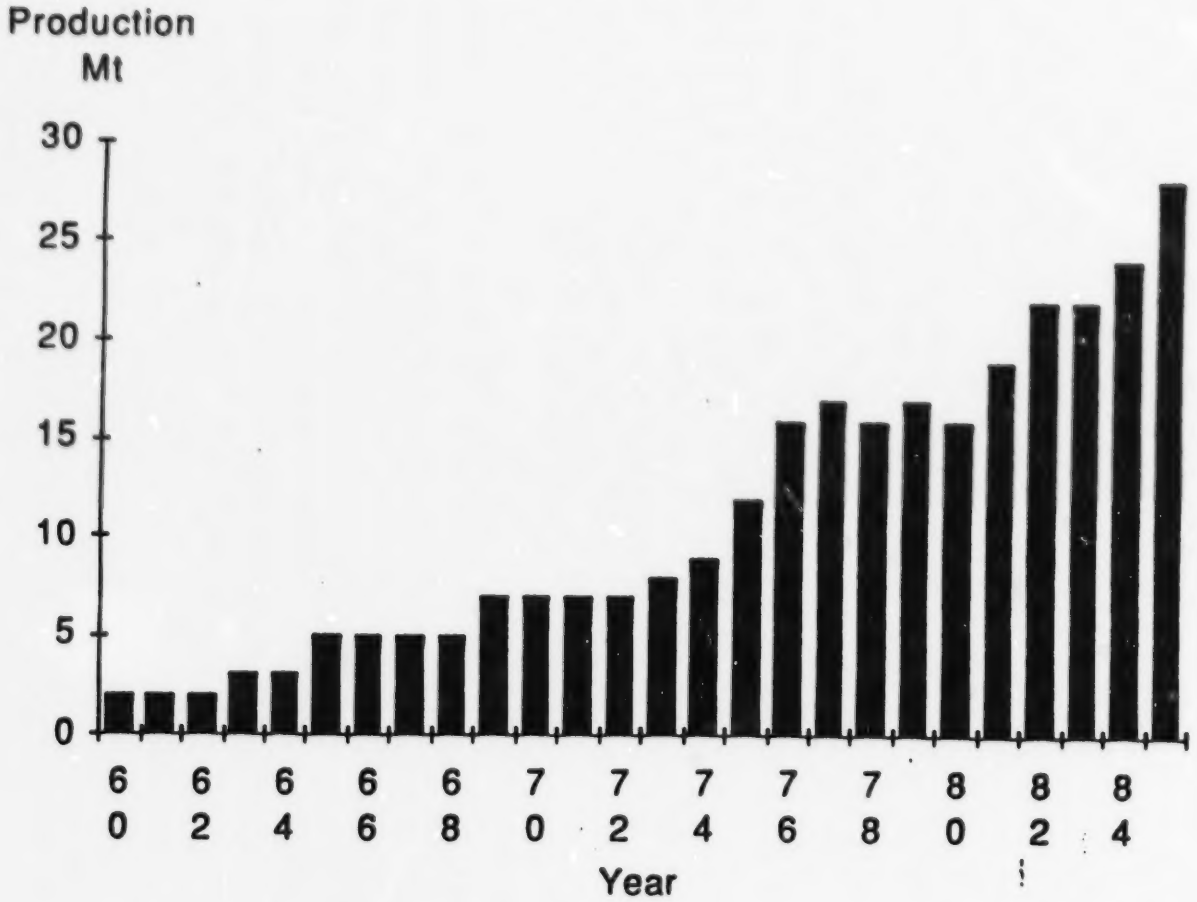

Fig. 3 - Lignite Production Graph

Operating Mines.

Main Field

The Main field was developed in 1957, with an annual target production of 1.8 Mt of lignite. In 1968, after modernization of the operating system, the production was increased to 6.0 Mt. The most significant change implemented was replacement of the rail system with conveyors.

North Field

The North field mine is the deepest mine of the basin. The preparatory work at the mine commenced in 1981. The continuous mining equipment from the Main pit is being gradually moved to this pit. At present time 5 BWEs and 2 stackers are used. In 1985 a total of 4 Mt of lignite was mined, target for 1986 and consecutive years is 5 Mt. The development of 5 benches is planned in the mine. The reserves are estimated to last till 2003.

Komanos Field

This field was designed for the period 1982-1994. The mine is under development, lignite production is averaging 3 Mt annually. First of five BWEs (C-700 type) commenced operation in mid of 1986, hydraulic stepping stackers and conveyors were also installed. The lignite transportation from the mine to outside customers will be by train. That train is being transfered from the Main field. Initial production of 5 Mt of lignite is planned, being reduced to 3.5 Mt in the later years.

Kardia Field

The mine was opened in 1970 following relocation of the Village of Kardia, which was moved to a new place. In 1980 the mine was separated into two sections, Western and Eastern, in order to overcome difficulties connected with the hard rock formations boundary extensions and also for economic reasons. The Western section retained its normal equipment, Eastern

section was supplied with two excavators and stackers from the South field. The equipment installed include C-300 excavators. The mining of lignite in this pit was contracted to an outside contractor.

A total production of 15.2 Mt was reached in 1984 year. Both sections have six working benches with excavators on each one. Two stackers are used for waste placement. The lignite is transported to the Kardia power station by belt conveyor system. The production is projected to last to 1991.

South field

The reserves of this field are equal to two thirds of the reserves of the mines which are in operation. The mine was opened in 1979 and has five excavators in overburden, with the largest having a capacity of 23 Mm^3/year and the other four 13 Mm^3/year. Four stackers, each having a capacity of 6,700 m^3/h, are operating at spoil side of the pit. Several villages were moved from the area of the pit, several more are planned to be moved as the pit progresses. The production at this field was delayed due to the existence of hard formation in the overburden. When the mine is in full production by the year 1990, 11 excavators, 2 shovel/crusher systems and 8 stackers of planned capacity up to 11,000 m^3/h, will be operational at the mine. A total excavation of 107 Mm^3 until the year 1990 will be made, with lignite production of 20 Mt. The transportation of lignite from the mine to Agios Dimitros and Kardia power stations will be by conveyor systems.

The lignite production for 1986 year is estimated to reach 3.5 Mt. A similar production is expected in 1987.

Figs. 4 and 5 are photos taken at Komanos field pit, shoving overall pit area and overburden removal operation at the north side of the pit.

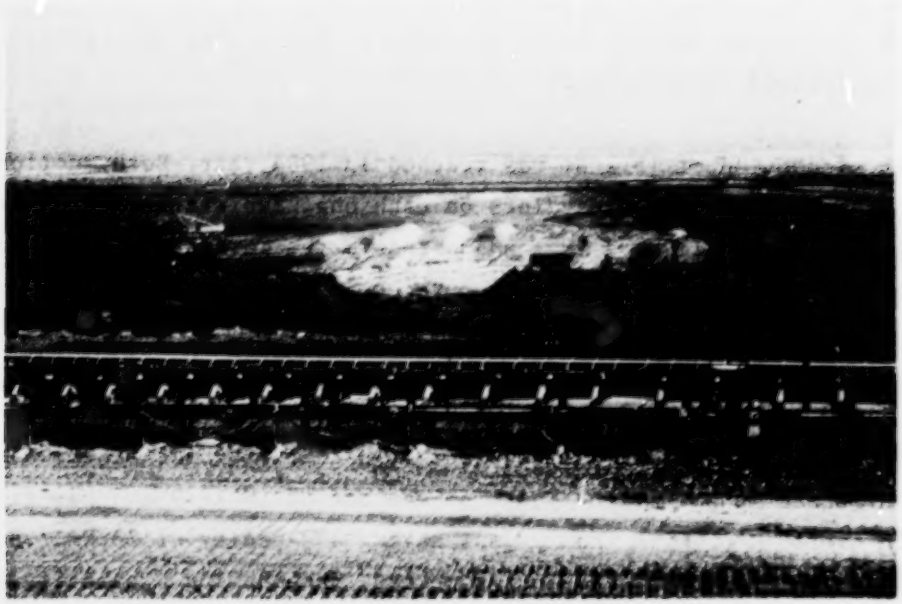

Fig. 4 - View of the Komanos Field Pit

Fig. 5 - Overburden Removal at Komanos Field Pit

Planned Mines.

Sector 6 - South Field

This development is planned to replace production from the Kardia field after is exhausted. An exploration study is in progress.

Amynteon Field

This mine is expected to supply lignite to two 300 MW units of the Amynteon power station. Three excavators are planned to operate in the overburden strata and three in lignite seams. The stripping ratio is expected to be in the 3.4/1 to 10.8/1 range. A total excavation of 80 Mm^3 of vaste and 8 Mt of lignite is planned. The starting date of operation on the first bench is proposed to be spring 1987. The preproduction excavation was by outside contractor using two C-700 excavators.

Reclamation.

The total area affected by the mining production in the Ptolemais region until the year 2025 will be 150,000 ha. Until the year 1984 the aquisition of land by the corporation reached 76,315 ha.

The environmental problems created by the lignite exploration are serious and complex, long and serious research is needed to address the problems. The exploitation in the basin commenced without studying and applying any programme of environmental restoration in the lignite fields. In some areas, the spoil was actually placed on surrounding lignite seams, and must now be removed again. Only since 1980 has the reclamation of the land has been studied. The Department of Environmental Restoration was established with an mandate to study the environmental problems and propose reclamation work. The tentative modelling of recultivation and planting of

trees in selected areas are underway. The mined out areas and also areas of temporary dumps, that are not expected to be removed during next 10 to 15 years, are being replanted. This is mainly done for esthetic reasons, but experience for eventual permanent restoration is also a factor.

To date, approximately 4,000 ha were restored. A systematic study is under way to determine which vegetation is the most suitable for reclamation of mined out land.

INDUSTRIAL INSTALLATIONS

These installations consist of the steam power station owned by Public Power Corporation in Athenai with installed capacity of 43 MW and the briquetting plant capable of production of 400 kt of briquettes annualy.

Power Station.

The power station's main fuel is lignite. Auxiliary fuel is the dust from the electrostatic precipitators produced during the lignite drying in the briquetting plant.

The power plant capacity with two boilers working in parallel is 160 t/h of steam. The pressure of the produced steam is 67 atm at a temperature of 495^{o} C. The steam is then distributed to one turbo generator with a power output of 33 MW, and to one back-pressure turbo generator with a power output of 10 MW and then to two steam turbines to operate the supplying pumps. The steam is then cooled to 200^{o} C and presssure reduced to 3.2 atm to be used at the briquetting plant for drying of lignite, and also for industrial and space heating. The turbo generators are connected to the National Power Network, while at the same time supplying 6 kW to the Main field and Kardia field mines.

Briquetting plant.

Type "A" lignite is treated at the briquetting plant. The lignite is crushed and ground to increase specific surface of the material then dryed and shaped into briquettes by compaction. Principal users of the product are households.

The plant annual production is up to 400 kt of briquettes. The dust from the dryer electrostatic precipitators totals 3.5 % of the plant required feed. Table 5 is a summary of the lignite feed and briquetting plant product analysis.

Table 5 - Analysis of Lignite and Briquetting Plant Products.

	ROM lignite	Dried lignite	Briquettes	Dust from el. precip.
Water content (%)	58	22	20	13
Ash on dry basis (%)	23	23	23	26
Heating value:				
Upper (kcal/kg)	1800	3700	3730	3940
Lower (kcal/kg)	1400	3400	3450	3690
Comp. strength (atm)	-	-	150	-

ACKNOWLEDGEMENT

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